MIGHT FAST B-VIOLATING TRANSITIONS BE FOUND SOON?

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Abstract

We claim that there might exist a new interaction leading to very fast baryon-number violating processes quite observable in the laboratory conditions, provided all three generations are simultaneously involved.

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1. Baryon-Antibaryon Mixings and Oscillations.

It was conjectured few years ago [1] that there could take place very fast baryon-number violating transitions with quite observable rates which however escaped observation up to now due to some specifics of the interaction. Specifically, it was conjectured [1] that there could be a baryon-number violating coupling originating in particles of electroweak masses and coupling strengths, provided all three generations are simultaneously involved. An example of what I am talking about is given by the coupling

$$\epsilon_{ijk}\lambda\phi_i q_j q_k, \tag{1}$$

ϕ being color-triplet scalar fields, q being right-handed quark fields, λ being the coupling constant and $i, j, k = 1, 2, 3$ are family indices. Note that the corresponding scalar fields are quite generic in the context of any GUT. Being interested in various aspects of baryon- antibaryon mixings and oscillations, I exhibited special interest in the Ξ_b (bus) baryon as the lightest one composed of quarks of all three generations which might undergo a lot of mixing with its antiparticle (see Fig. 1).

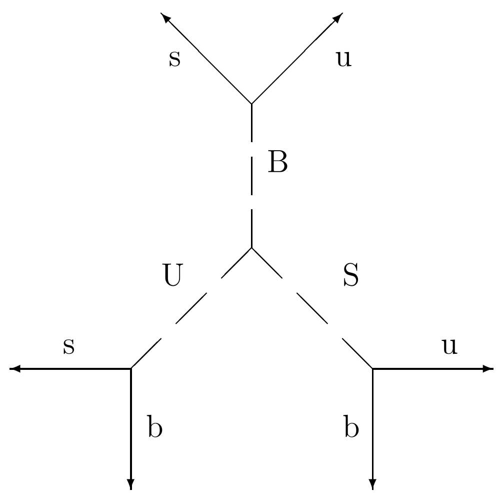

Fig. 1. $(bus) - (\bar{b}\bar{u}\bar{s})$ coupling. The dashed lines are color-triplet scalar fields ϕ; the solid lines are right-handed quark fields.

By rapid transitions $(bus) \leftrightarrow (\bar{b}\bar{u}\bar{s})$ I mean that the transition time, $\tau_{bus\leftrightarrow\bar{b}\bar{u}\bar{s}}$, is not excluded to be of order of the weak decay lifetime,

$$\tau_{bus\leftrightarrow\bar{b}\bar{u}\bar{s}} \sim 10^{-13}s. \tag{2}$$

It does not seem that such couplings would result in problems with FCNC and/or hyperon $\leftrightarrow$ anti-hyperon transitions. It seems that the most stringent constraints on the magnitude of the

coupling under consideration come from results of experimental searches of matter instability (proton decay, neutron-antineutron transitions in nuclei and in vacuum). However, what I am going to conjecture now, is the following. Remarkably enough, neutron-antineutron transitions originating from radiative electroweak corrections to the proposed interaction Fig. 1 being tremendously suppressed in comparison with $(bus) \leftrightarrow (\bar{b}\bar{u}\bar{s})$ transitions by factor $\sim (G_F^2)^2 \sim 10^{-20}$ might be well in the right range for experimental searches, with

$$\tau_{n\leftrightarrow\bar{n}} \sim 10^7 - 10^8 s. \tag{3}$$

Thus, fast enough baryon-number violating transitions might be looked for both by investigation of wrong signature weak decays of (bus)-like baryons and by searches of $n\bar{n}$ transitions.

2. A Speculation on ALEPH Events.

One may speculate on a possible relation of the assumed existence of these new scalars ϕ mediating baryon-number violating transitions to presumably observed recently 4-jet events by ALEPH. Such features of ALEPH events as no missing energy, absence of b-quarks in jets, relatively large yield in comparison with expectations might be easily understood in the framework of our hypothesis. Indeed, our colored scalars ϕ are coupled to quarks only and not to leptons. Second, if a pair of produced particles (with masses 55 GeV), giving two jets after their decay, is assumed to be a pair of ϕ's with the family index $j = 3$, then one should not expect b-quarks in jets at all. Finally, if there is indeed some excess in number of events observed, it might be explained by large electric charge of some of ϕ's.

3. Conclusions.

New rich physics might be well quite nearby! Searches are worthwhile both at accelerators and in low energy experiments and may proceed in several directions. Among them are, obviously, the following ones.

1. Production of pairs $\phi\bar{\phi}$ at hadron and electron colliders (in experiments like ALEPH).

2. Production of (bus)-like baryon-antibaryon pairs, say, at e^+e^- colliders, and search for wrong signature decays of produced baryons and antibaryons. Wrong signature is due to baryon-antibaryon mixing.

3. Search for $n\bar{n}$ oscillations in free neutrons beam. It might be well that even present sensitivity is already almost sufficient and we are close to observation of this phenomenon.

4. Search for induced matter instability.

The proposed new interaction might have a deep impact on generation of the baryon asymmetry of the Universe.

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References

[1] V. Kuzmin (1991),private communication to J.D. Bjorken, see: J.D. Bjorken, What Lies Ahead, preprint SLAC-PUB-5673, Oct. 1991, 13 p.p. In : *Corpus Christi 1991, Proceedings, Superconducting Super Collider* 653-665, invited talk given at 1991 Symp. on

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